Name: _____

MATTER IS MADE UP OF ATOMS

Chapter Outline

2.1 → Atoms and Their Structure

Vocabulary

atom	atomic theory	law of definite proportions
law of conservation of matter	mass number	~~scientific law~~
electron	proton	isotope
neutron	nucleus	atomic number

Objectives

- **Relate** historic experiments to the development of the modern model of the atom.
- **Illustrate** the modern model of an atom.
- **Interpret** the information available in an element block of the periodic table.

2.2 → Electrons in Atoms

Vocabulary

emission spectrum	energy level	electromagnetic spectrum
electron cloud	valence electron	Lewis dot diagram
atomic orbital	electron configuration	electromagnetic radiation
wavelength	frequency	amplitude
quantum		

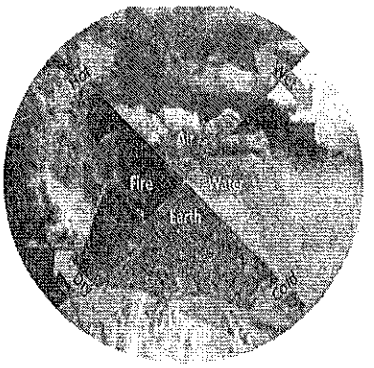
Objectives

- **Relate** the electron to modern atomic theory.
- **Compare** electron energy levels in an atom.
- **Illustrate** valence electrons by Lewis electron dot structure.
- **Define** a quantum of energy and **explain** how it is related to an energy change of matter.
- **Write** electron configurations using electron configuration notation.

Chapter 2 October 18th – November 7th

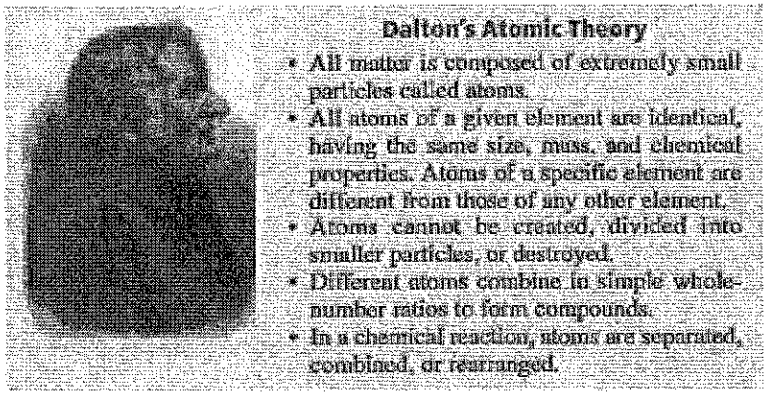
15 Activity: Bunsen Burner Lab	16	17 Early Dismissal	18 Video: The Atom	19 Notes: Early Atomic Theory Review: Bunsen Burner Lab
22 Demonstration: Cathode Ray Tu Notes: the Discovery of the Ele	23 Activity: JED Notes: Rutherfords Nuclear Mod	24 Activity: Ions Activity: Flame Test	25	26 Activity: Isotopes Notes: Atomic particles and prop
29 Due: Homework 1 and 2 Quiz: Homework 1 and 2 Review: Homework 1	30 Notes: Electron Configuration	31 Notes: Electromagnetic Spectru	Nov 1 Due: Homework 3 and 4 Quiz: Homework 3 and 4 Review: Homework 3 and 4	2 Review: Chapter 2
29 Due: Homework 1 and 2 Quiz: Homework 1 and 2 Review: Homework 1	30 Notes: Electron Configuration	31 Notes: Electromagnetic Spectru	Nov 1 Due: Homework 3 and 4 Quiz: Homework 3 and 4 Review: Homework 3 and 4	2 Review: Chapter 2
5 Study Guide Day	6 No School	7 Chapter 2 Test	8	9

MATTER IS MADE UP OF ATOMS
Chapter Notes Outline



Atomic Theory

- _____ (about 2,500 years ago)
- _____ (460-370 BC)
  - _____ are the smallest particles of matter and different types of atoms exist for every type of matter.
    - The idea that matter is made up of fundamental particles called atoms is known as the _____ of matter.
- _____ (1782)
  - When a chemical reaction occurs, matter is neither created nor destroyed but only changed.
    - This became known as the _____.
- _____ (1799)
  - The elements that compose a compound are always in a certain proportion by mass.
    - This principle is now referred to as the _____.
- _____ (1803)



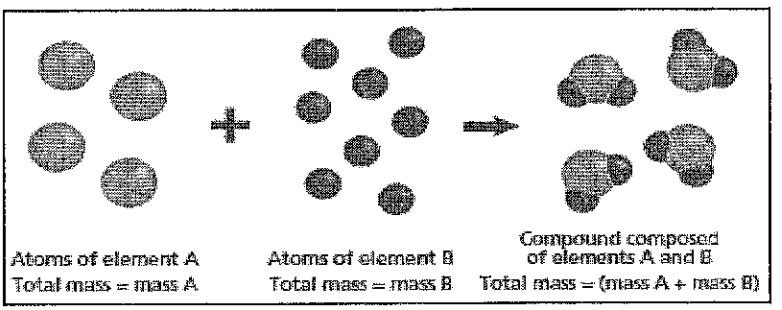


Figure 4-5
Dalton's atomic theory explains the conservation of mass when a compound forms from its component elements. Atoms of elements A and B combine in a simple whole-number ratio, in this case two B atoms for each A atom, to form a compound. Because the atoms are only rearranged in the chemical reactions, their masses are conserved.

Atomic Particles

- _____ (1897)
  - Discovered that Dalton's _____ was not accurate.

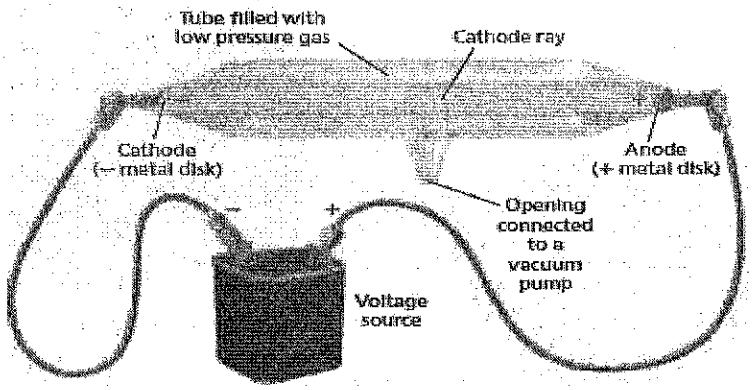
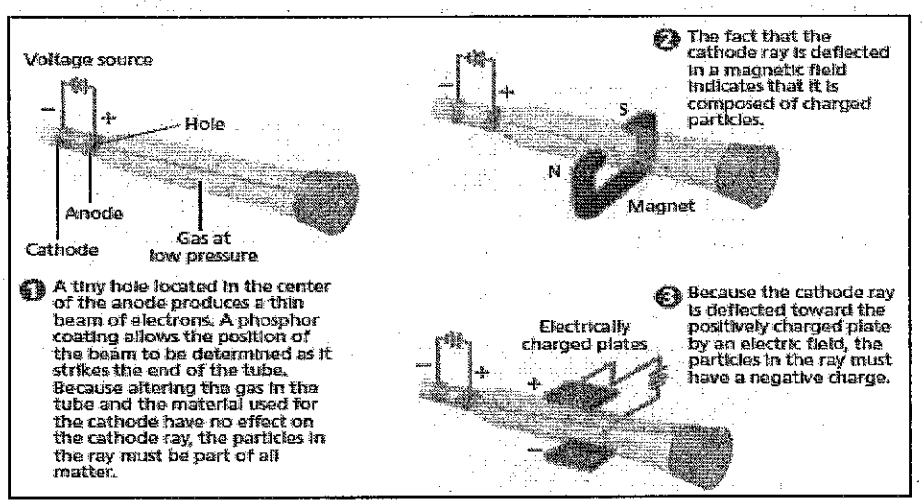


Figure 4-7

Examine the parts of a typical cathode ray tube. Note that the electrodes take on the charge of the battery terminal to which they are connected. The cathode ray travels from the cathode to the anode.



- Conclusion...
  - The rays bent _____ a _____ charged plate and _____ a _____ charged plate.
    - Objects with _____ each other, and objects with _____ each other.
  - Cathode rays are made up of invisible, _____ charged particles referred to as _____.
- Further Developments...
  - Scientists also determined that the rays in the cathode ray tube were also composed of _____ charged subatomic particles called _____.
- J.J. Thomson (1910)
  - Atoms of an element that are chemically alike but differ in mass are called _____ of an element.
    - The existence of a _____ particle, called a _____, was confirmed in the early 1930s.

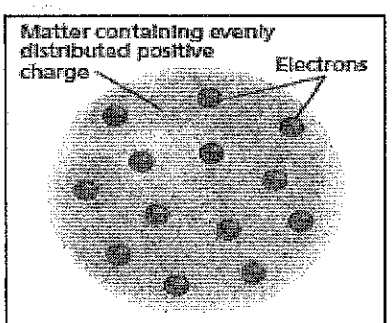


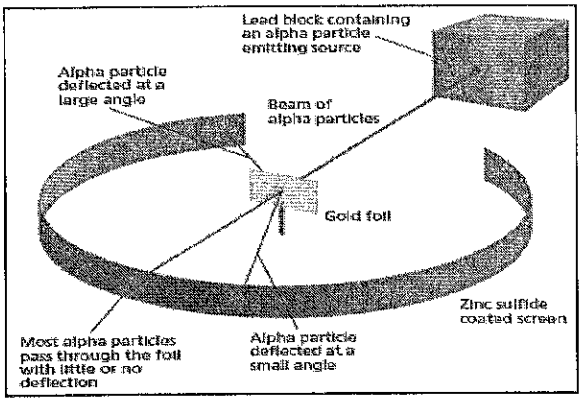
Figure 4-9

J.J. Thomson's plum pudding atomic model proposed that negatively charged electrons were distributed throughout a uniform positive charge.

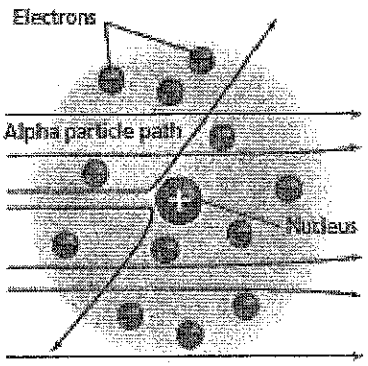
- _____ (1909)
  - Revealed that Thomson's _____ was not accurate.

Figure 4-11

As Rutherford expected, most all of the alpha particles passed straight through the gold foil, without deflection. Surprisingly, however, some alpha particles were scattered at small angles, and on a few occasions they were deflected at very large angles.



- Conclusion...
  - Because most of the particles passed through the foil, they concluded that _____ _____.
  - Because a few particles were deflected, they proposed that the atom has a _____, _____, _____, called a _____.



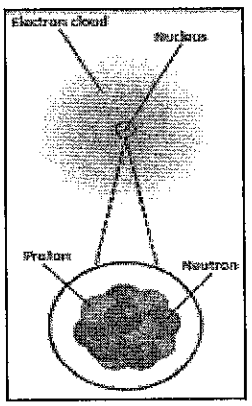


Table 4-1

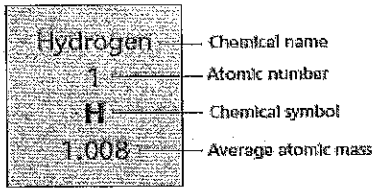
Properties of Subatomic Particles					
Particle	Symbol	Location	Relative electrical charge	Relative mass	Actual mass (g)
Electron	e^-	In the space surrounding the nucleus	1–	$\frac{1}{1840}$	9.11×10^{-28}
Proton	p^+	In the nucleus	1+	1	1.673×10^{-24}
Neutron	n^0	In the nucleus	0	1	1.675×10^{-24}

- The _____ of an element is the _____ in the nucleus of an atom of that element.
  - It is the number of protons that _____ of an element, and well as many of its chemical and physical properties.

Atomic number = number of protons = number of electrons

- The _____ in the nucleus is the _____ of that particular atom.
  - Isotopes of an element have _____ because they have _____, but they all have the _____ _____.

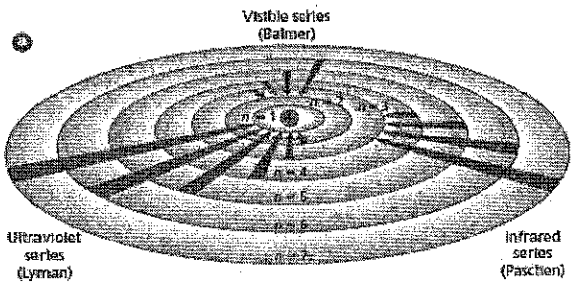
- The number at the bottom of each box is the _____ of that element.

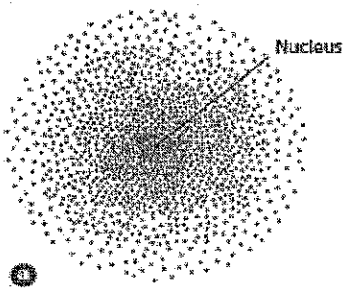


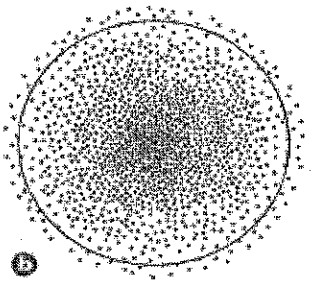
  - This number is the _____ of all the naturally occurring isotopes of that element.

Electron Configuration

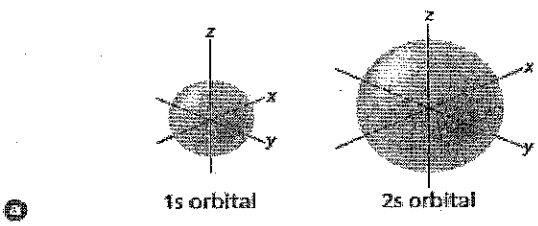
- _____ (1913)
  - He proposed that atoms have only certain allowable energy states.
    - _____
    - _____
  - Electrons move around the nucleus in only certain allowed circular _____.

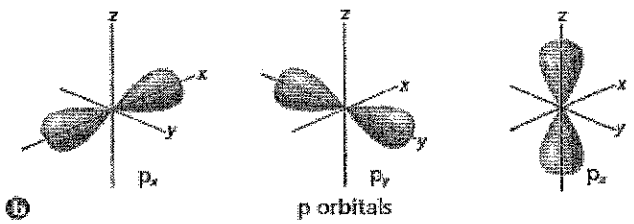






- Bohr's _____ was found to be inaccurate.
  - The _____ shows that electrons are most likely to be found in certain spherical regions of space around the nucleus.
    - The space around the nucleus of an atom where the atom's electrons are found is called the _____.
- A three-dimensional region around the nucleus called an _____ describes the electron's probable location.
- The arrangement of electrons in an atom is called the atom's _____.
  1. _____ (1, 2, 3, 4, etc...)
  2. _____ (s, p, d, or f)
  3. _____

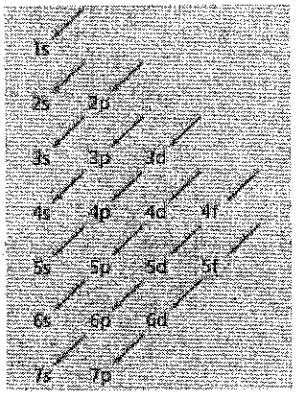




4. The _____ in those orbitals.

Energy Level	Sublevel	Atomic Orbitals	Number of Electrons
1	s	1	2
2	s, p	1, 3	2, 6
3	s, p, d	1, 3, 5	2, 6, 10
4	s, p, d, f	1, 3, 5, 7	2, 6, 10, 14

- Aufbau Diagram



- Example
  - Write the electron configuration of neon.

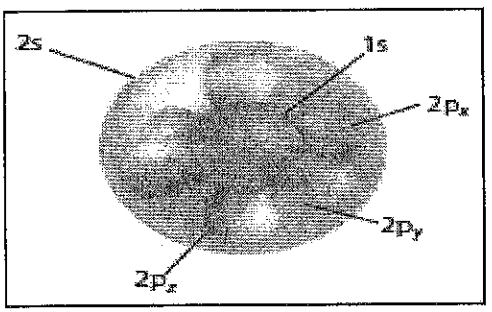
    ELECTRONS? _____

    ELECTRON CONFIGURATION?

    _____

Figure 5-18

The 1s, 2s, and 2p orbitals of a neon atom overlap. How many electrons does each of neon's orbitals hold? How many electrons in total does neon's electron cloud contain?



- The electrons in the outermost energy level are called _____.
  - When atoms come near each other, it is these electrons that interact with one another.
  - Many of the chemical and physical properties of an element are directly related to the

    _____ and _____ of valence electrons.

- A _____ illustrates valence electrons as dots around the chemical symbol of the element.
  - Each dot represents one valence electron, and the element's symbol represents the core of the atom (the nucleus plus all the inner electrons.
- Example...
  - Write the electron configuration and Lewis dot diagram for an atom of boron.

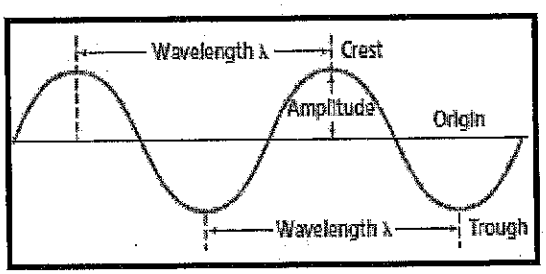
    ELECTRONS? _____ ELECTRON CONFIGURATION? _____

    VALENCE ELECTRONS?_____ SYMBOL? _____

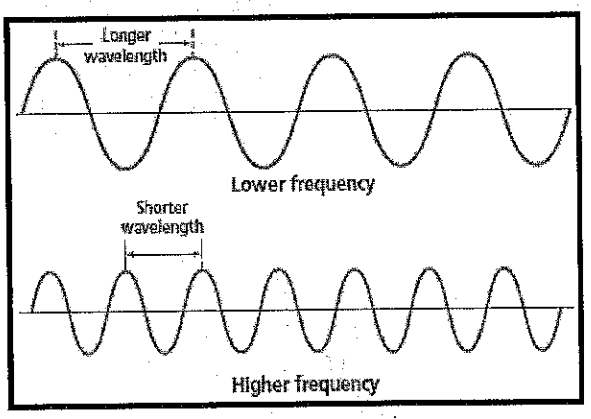
    LEWIS DOT DIAGRAM?

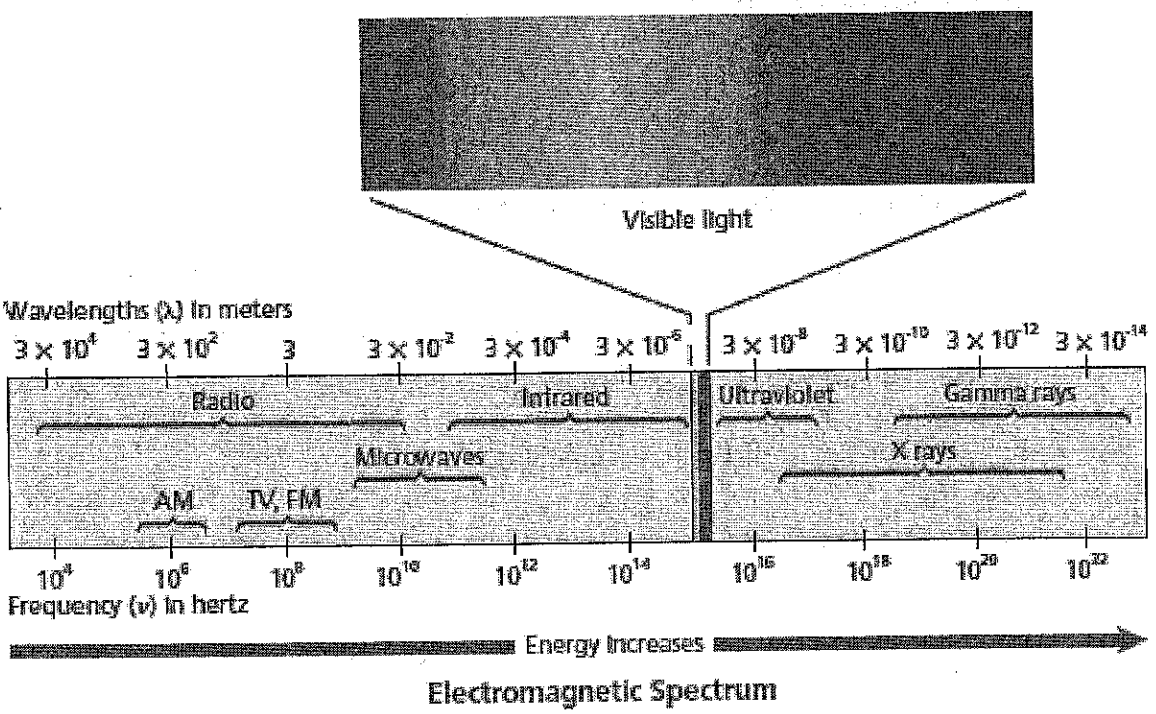
Electromagnetic Spectrum

- _____ is a form of energy that exhibits wavelike behavior as it travels through space.
  - All of the forms of radiant energy are parts of a whole range of electromagnetic radiation called the _____.
    - All waves can be described by several characteristics...
      - ✓ _____ (_____) is the shortest distance between equivalent points on a continuous wave (_____, _____, or _____).
      - ✓ _____ (_____) is the number of waves that pass a given point per second (_____, _____, or _____).
      - ✓ _____ is the wave's height from the origin to a crest (or to a trough).
      - ✓ All waves travel at the _____ of light (_____).



$$c = \lambda\nu$$





Electromagnetic Spectrum

- Example...
  - What is the wavelength of a microwave having a frequency of 3.44×10^9 Hz?
    KNOWNS & UNKNOWNS

    FORMULA _____ REARRANGED FORMULA _____

    PLUG-IN NUMBERS

    ANSWER (with unit) _____

- Matter can gain or lose energy in only small, specific amounts called quanta.
  - A _____ is the minimum amount of energy that can be gained or lost by an atom.
    - E = energy in _____ (_____)
    - h = Planck's constant = _____ (_____)
    - v = frequency in Hertz (Hz)

$$E_{quantum} = h\nu$$

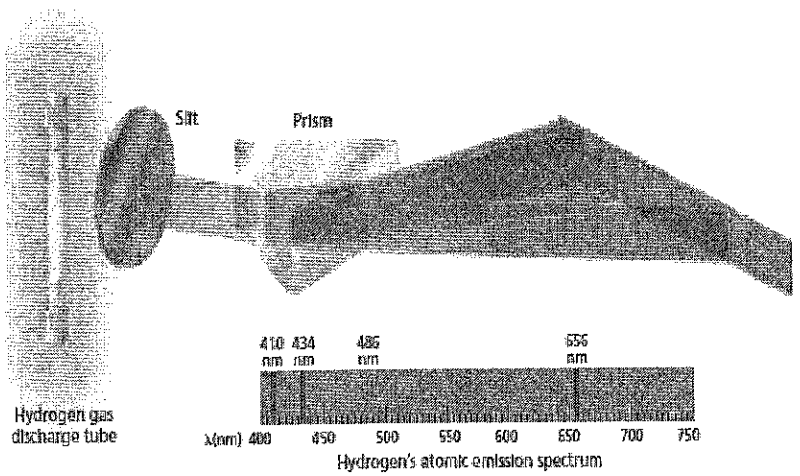
- Example...
  - Tiny water drops in the air disperse the white light of the sun into a rainbow. What is the energy of a photon from the violet portion of the rainbow if it has a frequency of 7.23×10^{14} Hz?
    KNOWNS & UNKNOWNS

    FORMULA _____ REARRANGED FORMULA _____

    PLUG-IN NUMBERS

    ANSWER (with unit) _____

- The _____ of an element is the set of frequencies of the electromagnetic waves emitted by atoms of the element.



Hydrogen's atomic emission spectrum

NAME: _____ SCORE: _____ / 40

Homework Assignment #1 *Due:* _____

1. Compare Democritus' ideas about the atom with those of Dalton.

2. What was Lavoisier's contribution to the development of the modern atomic theory?

3. What are the major points in Dalton's atomic theory?

4. What were the four elements according to the Greek philosophers?

Homework Assignment #2 *Due:* _____

1. Why did Rutherford conclude that an atom's nucleus has a positive charge instead of a negative charge? Summarize the conclusions that Rutherford's team made about the structure of an atom.

2. The isotope of carbon that is used to date prehistoric fossils contains six protons and eight neutrons. What is the atomic number of this isotope? How many electrons does it have? What is its mass number?

3. Fill in the following table:

Element	Symbol	# of Protons	# of Electrons	# of Neutrons	Mass Number
Magnesium				12	
Polonium			84		125
	Fe			30	

Homework Assignment #3 *Due:* _____

1. Write the electron configurations for the following elements.
   a. bromine _____
   b. strontium _____
   c. antimony _____
   d. titanium _____
2. Write the Lewis dot diagrams for the elements listed in #1.

3. How many electrons occupy p orbitals in a chlorine atom?

Homework Assignment #4 *Due:* _____

1. What is the frequency of green light, which has a wavelength of 4.90×10^{-7} m?

2. What is the speed of an electromagnetic wave that has a frequency of 7.8×10^{6} Hz?

3. What is the energy of radiation with a frequency of 9.50×10^{13} Hz?

4. Describe the relationship among frequency, wavelength, and energy of electromagnetic waves.

Name: _____

SCORE: _____ / 15

Chemistry 313
Chapter 2

MATTER IS MADE UP OF ATOMS

Study Guide

1. Define the following terms:

   a. atom

   b. atomic number

   c. electron

   d. electron cloud

   e. emission spectrum

   f. energy level

   g. atomic theory

   h. isotope

i. law of conservation of matter

j. law of definite proportions

k. Lewis dot diagram

l. mass number

m. neutron

n. nucleus

o. proton

p. atomic orbital

q. wavelength

r. quantum

s. valence electron

t. electron configuration

u. frequency

v. electromagnetic spectrum

w. electromagnetic radiation

x. amplitude

2. Draw the four models of the atom as they evolved through history (Dalton, Thomson, Bohr, Electron Cloud).

3. Describe the relationship between frequency, wavelength, and energy.

4. Sulfur has 4 isotopes: 94.93% of S-32, 0.76% of S-33, 4.29% of S-34, and 0.02% of S-36. What is the average atomic mass of sulfur?

5. What does the electromagnetic spectrum have to do with electrons? More specifically, how are electrons able to emit light?

6. Calculate the energy of a photon that has a wavelength of 8.72×10^{-2} m.

7. Write the electron configurations and Lewis dot structures for the following atoms.

   a. carbon

   b. chlorine

   c. calcium

   d. argon